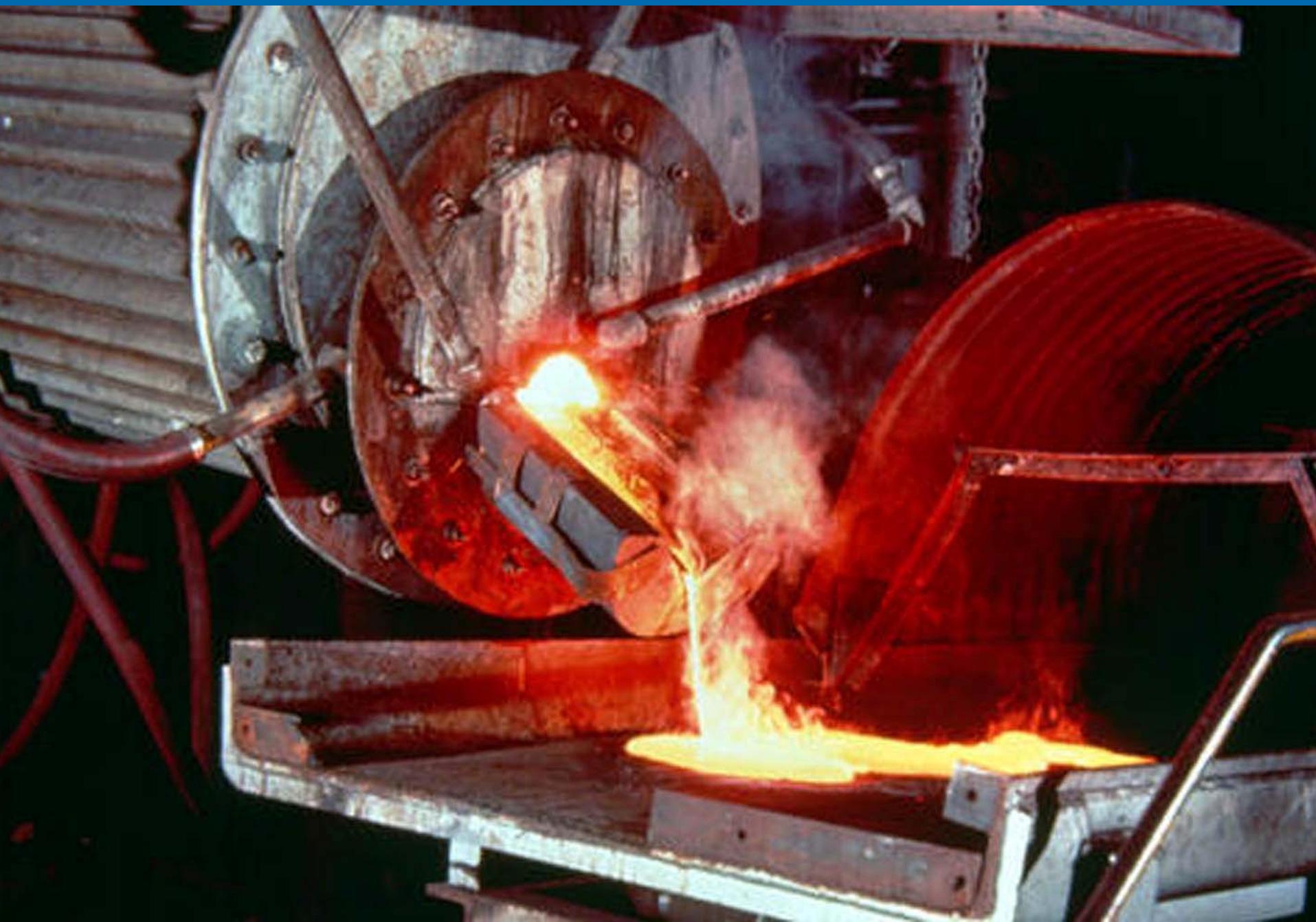




# TCLP & Foundry Waste

## Iron Treatment of Lead-Contaminated Waste



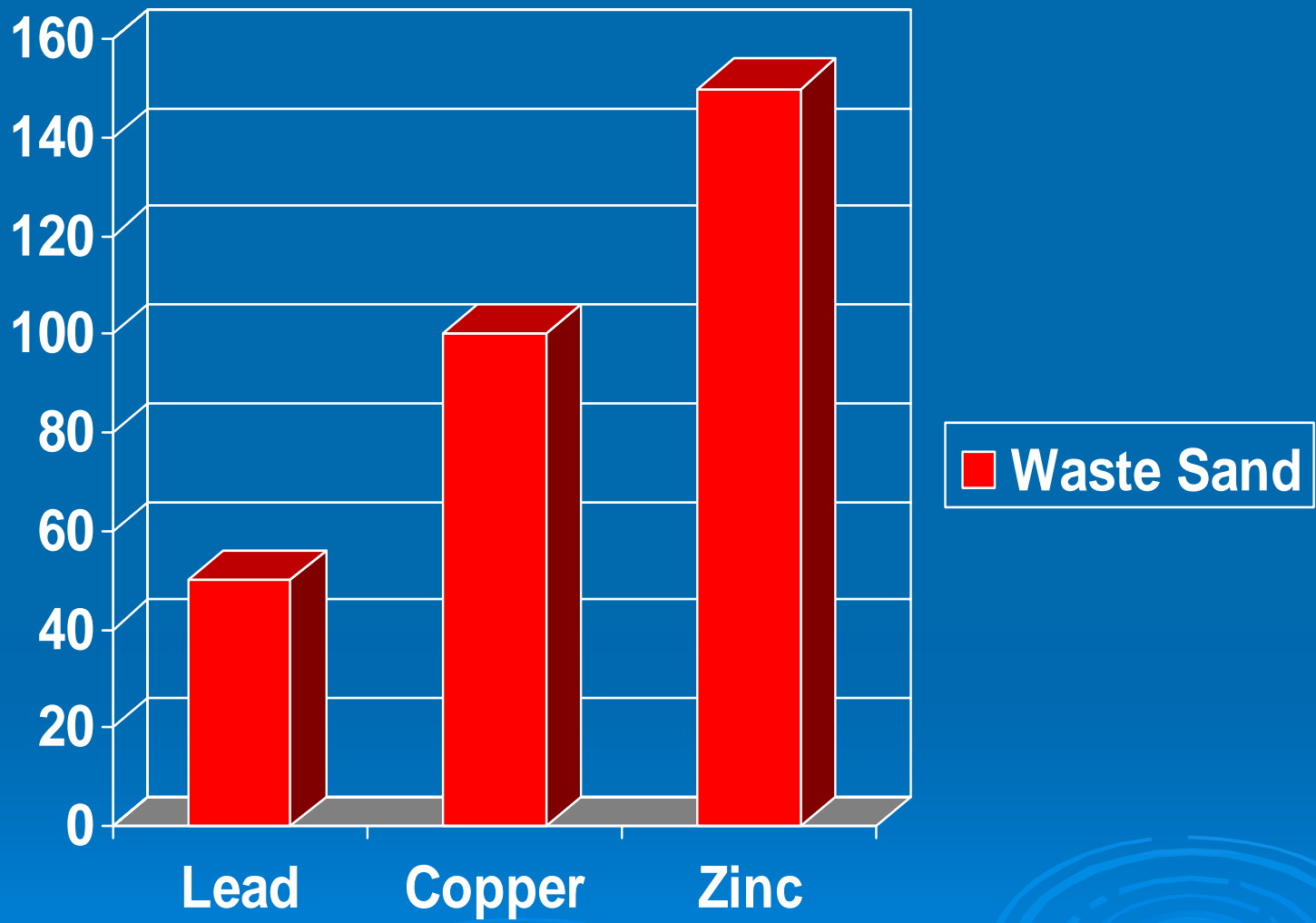


# Brass Foundries

- Copper, zinc and lead in brass
- Lead from recycled brass (cars)
- Molten brass cast in sand molds
- Waste sand hazardous

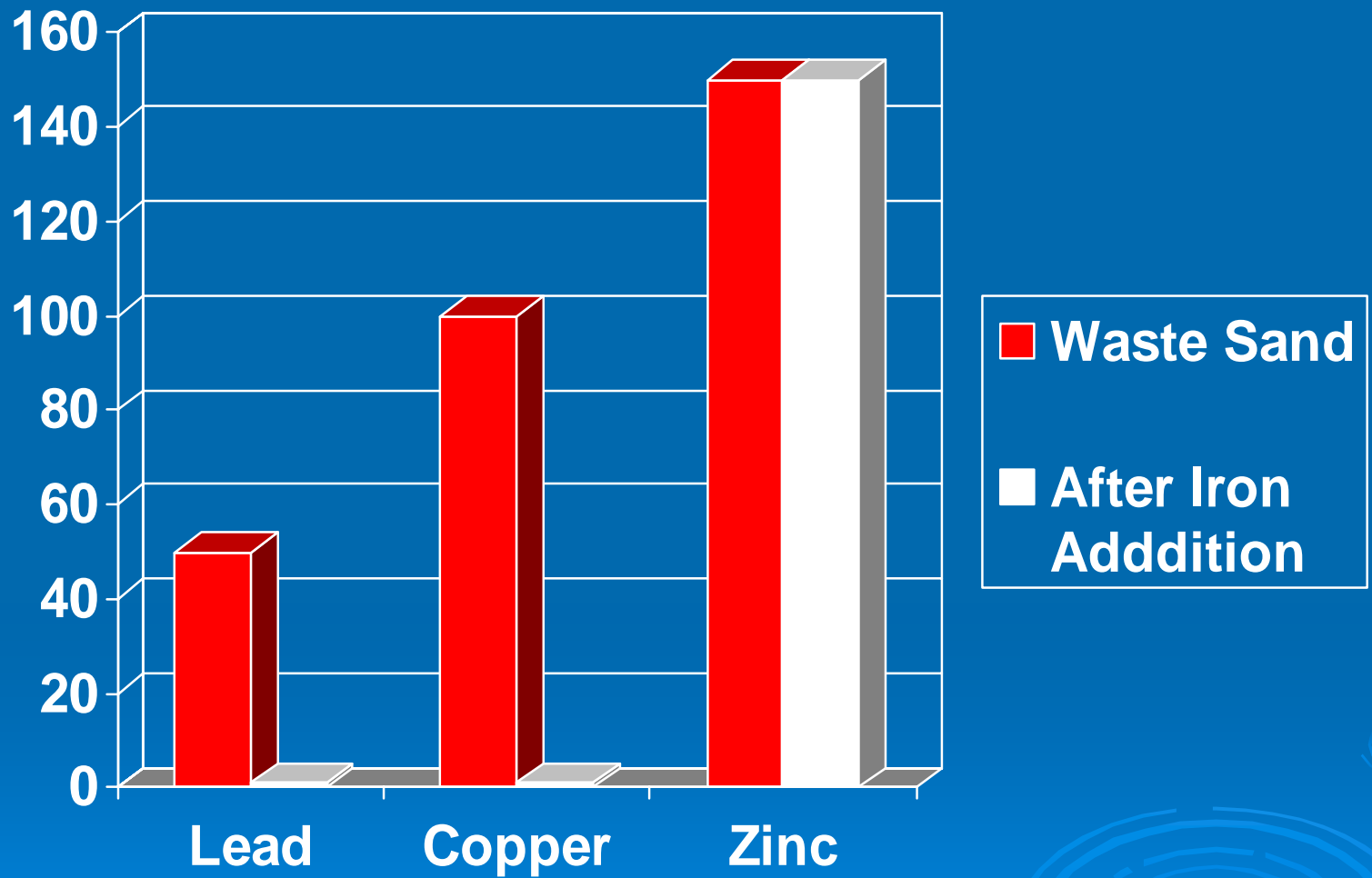
# Toxicity Characteristic Leaching Procedure

- 18 Hour extraction
- >100 grams waste (1/4 lb.)
- Extract with 0.1 M acetate
- pH = 2.93 or 4.93
- Model Landfill

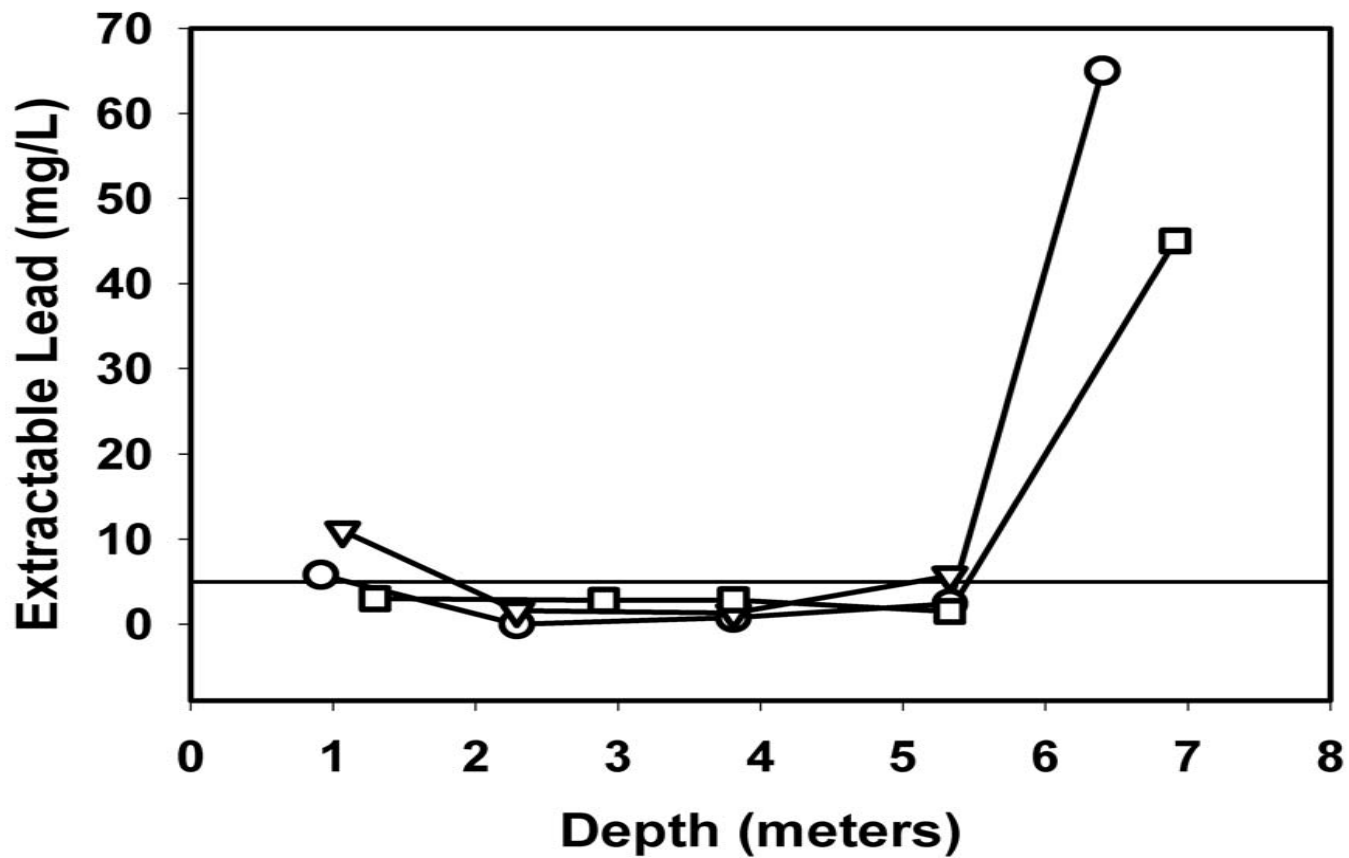


# Iron Metal Addition

- Add 10% Iron to Waste Sand
- TCLP lead < 1 mg/L
- Iron amended waste disposed of in separate cells of municipal landfill



# Landfill TCLP



# Iron Chemistry

➤ Fe      Iron Metal

➤ Fe<sup>2+</sup>      Ferrous ion

➤ Fe<sup>3+</sup>      Ferric ion

# Iron Metal

## Oxidation Reduction

➤  $\text{Zn} > \text{Fe} > \text{Pb} > \text{Cu}$

➤ Iron will reduce lead and copper, but not zinc

➤  $\text{Fe} + \text{Pb}^{2+} \Rightarrow \text{Fe}^{2+} + \text{Pb}$



# Oxidation States in Solution

- Fe(II) More stable in  
absence of  $O_2$   
More soluble
- Fe(III) More stable in air  
Less soluble

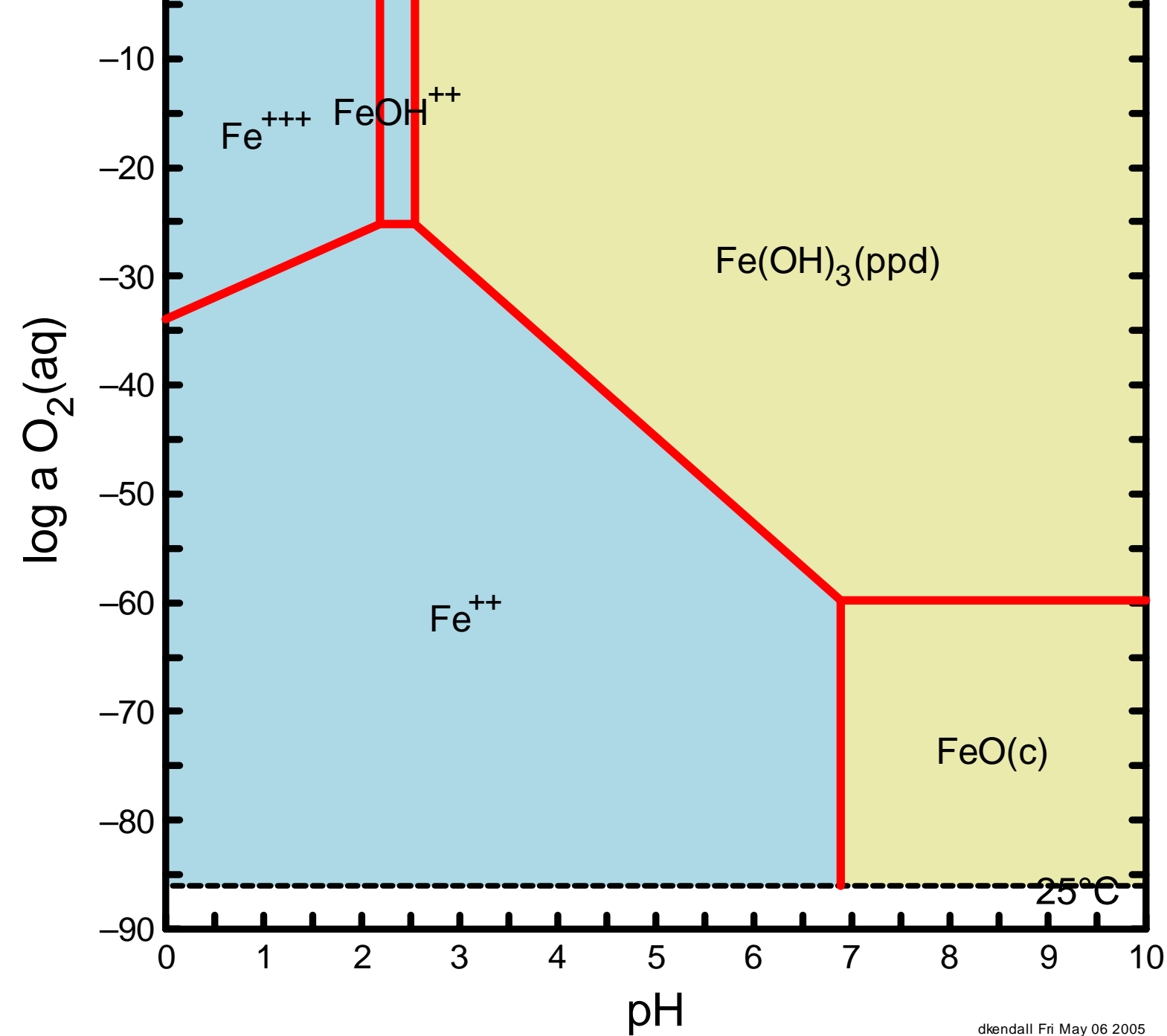


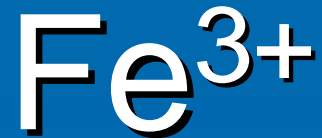
Diagram  $\text{Fe}^{++}$ ,  $T = 25^\circ\text{C}$ ,  $P = 1.013 \text{ bars}$ ,  $a[\text{main}] = 10^{-2.398}$ ,  $a[\text{H}_2\text{O}] = 1$ ; Suppressed: Hematite, Magnetite, Goethite

# TCLP vs. Landfill

➤ TCLP



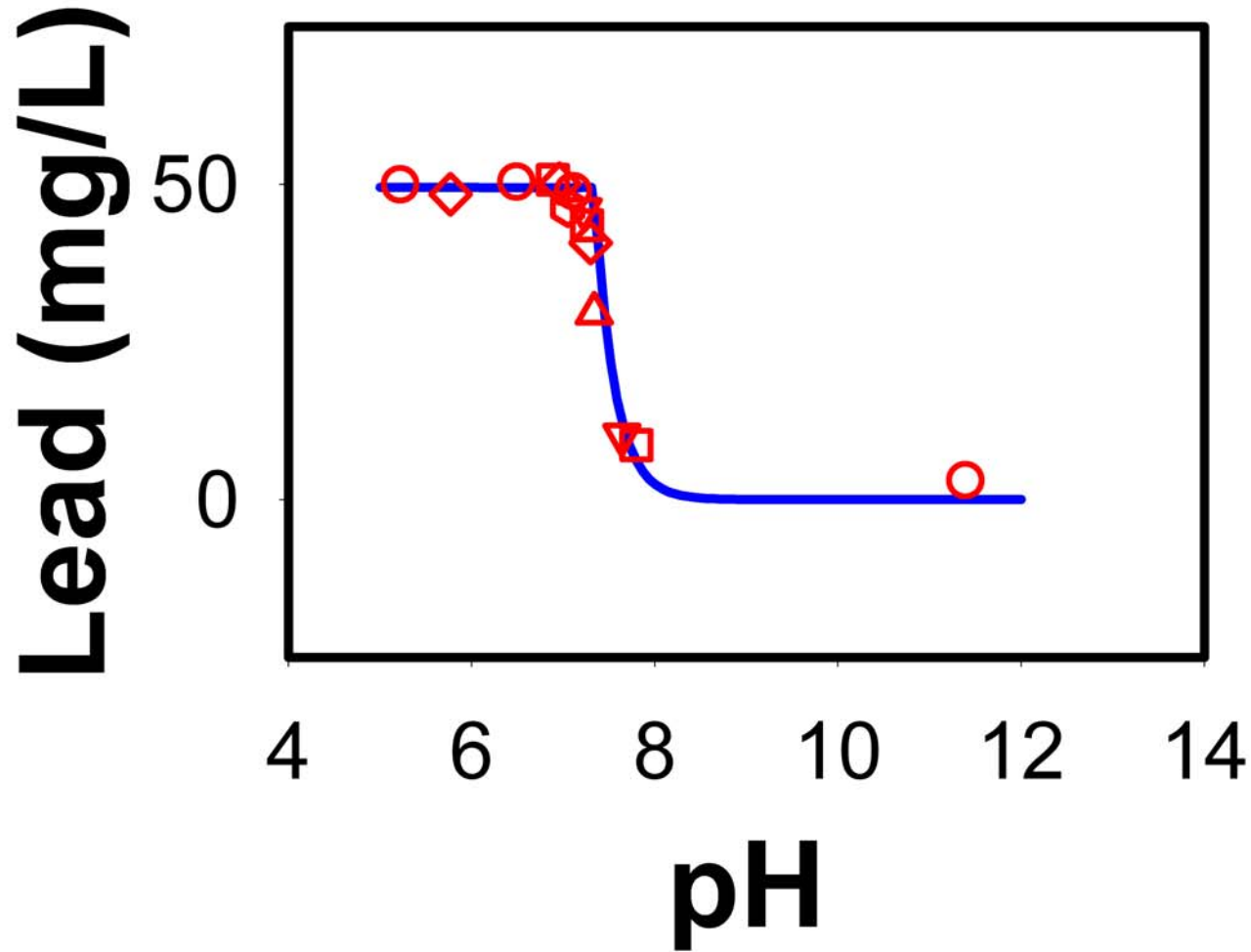
➤ Landfill



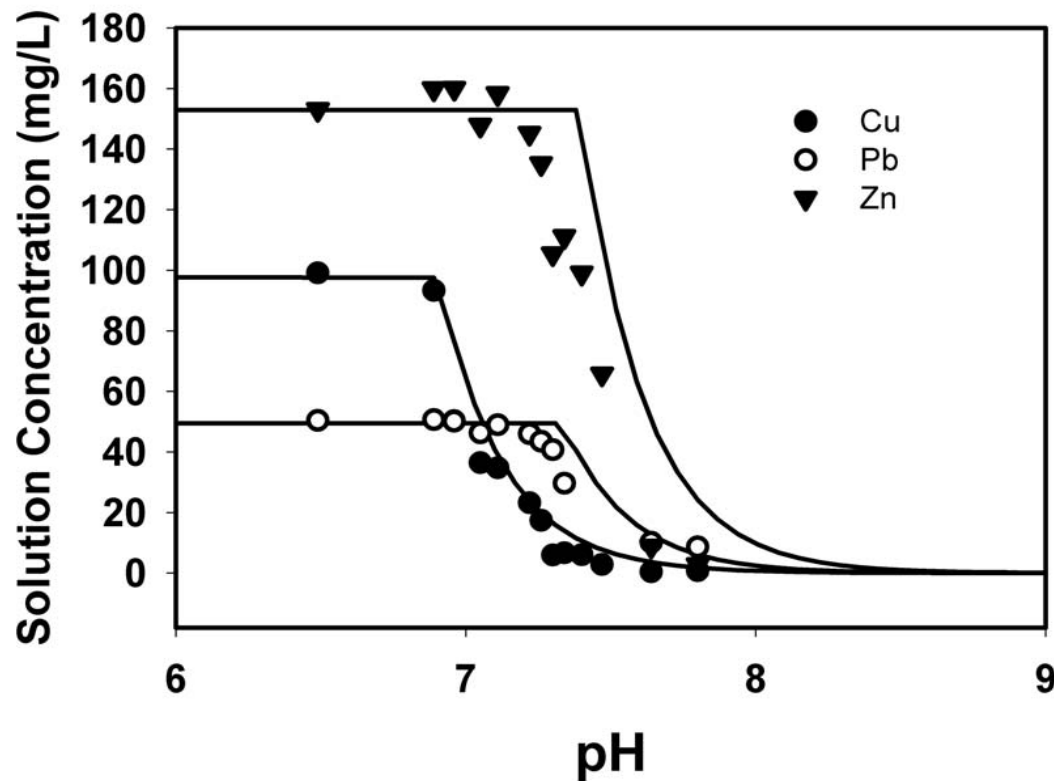
# Consider Two Reactions of $\text{Fe}^{3+}$

- Precipitation of Hydroxides
- Sorption by Hydrous Ferric Oxide (HFO) or  $\text{Fe}(\text{OH})_3$

# Lead Hydroxide



# Precipitation of Hydroxides



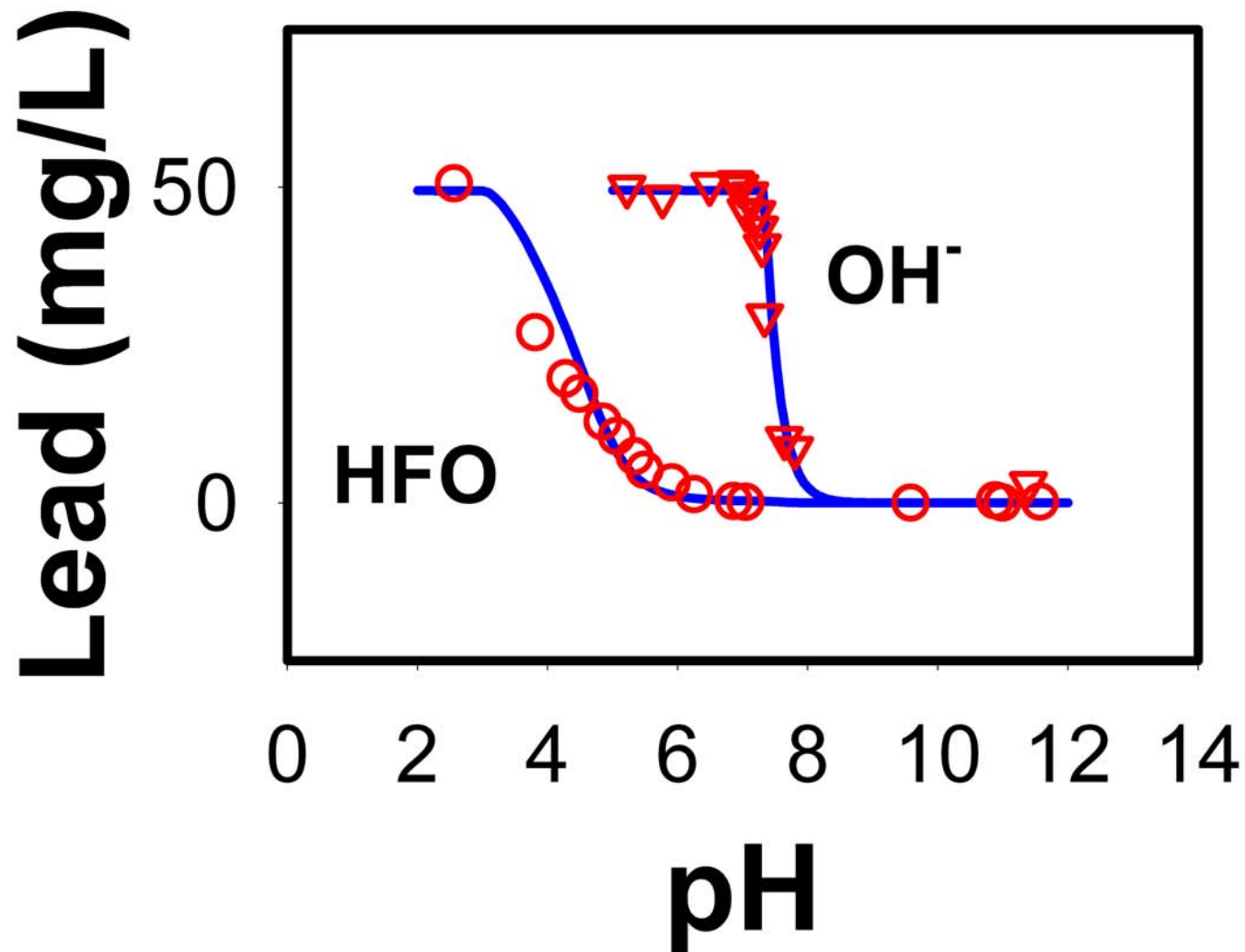
# Adsorption by HFO

## ➤ Hydrous Ferric Oxide (HFO)

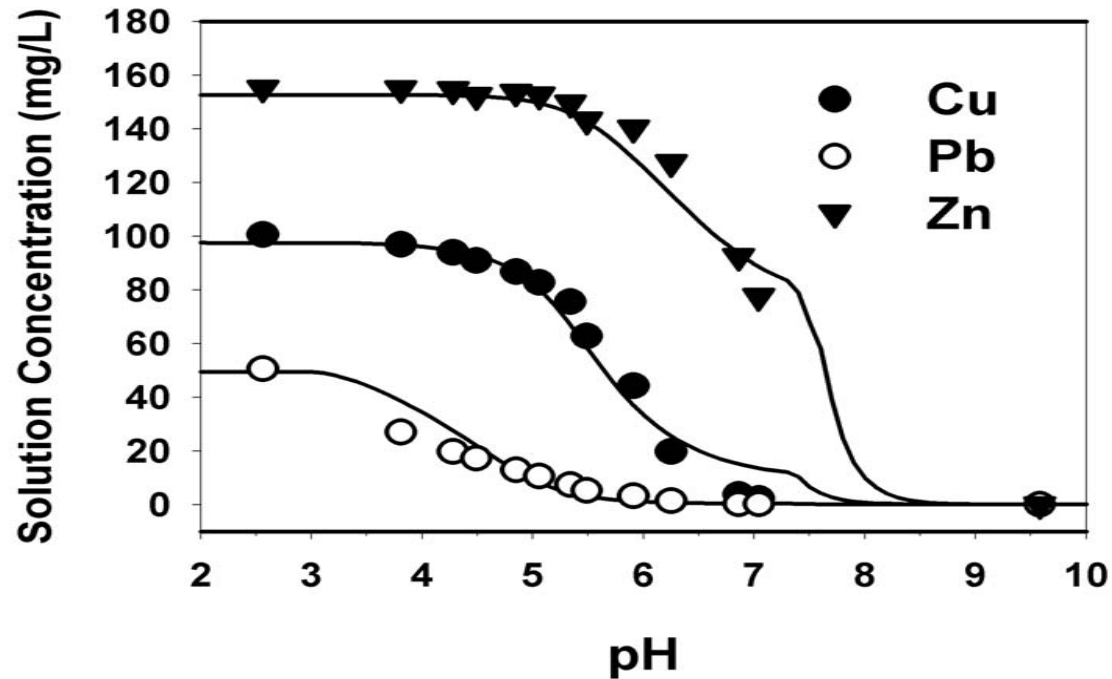


## ➤ Can absorb lead, copper and zinc

# Lead



# Sorption by HFO



# Comparison

## HFO Sorption vs. Redox

### ➤ Copper

More easily reduced – Cu concentration lower than lead if redox

Adsorbs less than lead – Cu concentration greater than lead if sorption

# Iron in the TCLP

- Extraction in a sealed container

Reducing environment  
Oxygen depleted

- Dissolved Iron is  $\text{Fe}^{2+}$   
HFO cannot form

# In the Landfill

- Iron metal will oxidize
- HFO may form & adsorb Pb, Cu and Zn
- Iron treatment NOT a long term stabilization method.

# TCLP

## ➤ Results Influenced by Many Factors

pH

Redox environment (iron)

Complexing Agents

Additives (lime, phosphate)

# TCLP

- Suggestion: Use totals to determine if regulation required
- Generator can delist if long term safety and stability can be demonstrated.